Volume 2

Chapter 19 System Reoperation

System reoperation may improve the efficiency of existing uses, or it may increase the emphasis of one use over another. The temperature control device at Shasta Dam allows operators to operate the dam for salmon protection and recovery, as well as hydroelectric power production. (DWR photo)

Chapter 19 *System Reoperation*

System reoperation means changing existing operation and management procedures for such water facilities as dams and canals to meet multiple beneficial uses (see Box 19-1). System reoperation may improve the efficiency of existing uses, or it may increase the emphasis of one use over another. In some cases, physical modifications to the facilities may be needed to expand the reoperation capability. Population growth, with its commensurate demand for more water, better understanding of the environmental impacts of water development, and changing laws and values, have created incentives to evaluate how existing facilities can be reoperated to provide the best use of the facilities.

Extent of System Reoperation

System reoperation is not a new tool for water managers. A 1976-1977 drought prompted many water agencies to move away from the firm-yield approach to operating water projects to a risk-based approach when making system delivery decisions. The firm-yield approach seeks to deliver the same amount every year regardless of water supply conditions while the risk-based approach balances increasing deliveries in a given year with the risk of not meeting full deliveries in a subsequent dry year. The risk-based approach has increased average deliveries of the State Water Project. Several large-scale regulatory and water planning and management efforts started over the past decade have prompted project operators to explore system reoperation. These efforts include implementation of the Central Valley Project Improvement Act (CVPIA), SWRCB Bay-Delta Decision 1641, The CALFED Bay-Delta Program, and hydroelectric facility relicensing. Concerns about the potential effect of global climate change have also influenced reoperation planning.

Box 19-1 Examples of System Reoperation

- Changes in timing or volume of reservoir water storage and releases to accommodate changing priorities of the project, such as improving or managing instream conditions, recreation opportunities, flood management, local water supplies, or water quality.
- Using temperature control devices in reservoirs to permit water to be released from variable depths in order to manage the water temperature and water quality downstream for endangered species protection while maintaining hydroelectric power generation.
- Increasing the water storage and flood retention capacity of reservoirs by conveying reservoir water to groundwater banks before the refill season.
- Coordinating and interconnecting water storage, water conveyance, and water delivery systems within a watershed or geographic area to improve benefits to the local watershed area, the regional watershed area, and the state.
- Balancing water supply and delivery forecasts with the economic and environmental risks that water users and regulatory agencies may be willing to accept if full deliveries are not met. The ability to customize risk tolerances to users may allow overall improvements in system efficiency.

The CVPIA, signed into law October 30, 1992, mandated changes in management of the Central Valley Project, particularly for the protection, restoration, and enhancement of fish and wildlife. This has led to changes in water supply contracts, reallocation of water for environmental benefits, increased use of voluntary water transfers, and implementation of water use efficiency measures. One example of reoperation that was prompted by CVPIA was the installation of the Temperature Control Device (TCD) at Shasta Dam at a cost of $80 million. The TCD is a shutter type mechanism designed to draw water from the different levels of Shasta Lake and release it through powerhouse turbines, providing cold water for endangered winter run Chinook salmon spawning downstream in the Sacramento River, while maintaining hydroelectric power generation. Water is drawn from different levels of the lake at different times of the year to match the downstream requirements and to manage the cold water reserves behind the reservoir.

The State Water Resources Control Board adopted Decision 1641 (D-1641) on December 29, 1999. The decision implements flow and water quality objectives for the Bay-Delta Estuary set forth in the 1995 Bay-Delta Plan, adopted May 22, 1995. D-1641 recognizes that many of the objectives in the 1995 Bay-Delta Plan are best implemented by making changes in the flow of water or in the operation of export facilities. Accordingly, D-1641 includes aspects of system reoperation by approving changes to points of diversion of the Central Valley Project and the State Water Project in the southern Delta, and approving changes in places of use and purposes of use of water developed and distributed by the Central Valley Project.

The purpose of CALFED Bay-Delta Program is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The program was formalized with the approval of the Record of Decision on August 28, 2000, by the state and federal agencies with management and regulatory responsibility in the Bay-Delta Estuary. The Framework Agreement pledged that the state and federal agencies would work together in three areas of Bay-Delta management: 1) Water quality standards formulation; 2) Coordination of State Water Project and Central Valley Project operations with regulatory requirements; and 3) Long-term solutions to problems in the Bay-Delta Estuary. All three components include system reoperation combined with other water management strategies to make improvements. The Environmental Water Account (EWA) is an element of the CALFED Bay-Delta Program's overall management strategy for the Bay-Delta ecosystem. EWA's purpose is to provide greater protection to the fish of the Bay-Delta Estuary than current regulatory requirements through environmentally beneficial changes in the operations of the CVP and SWP at no uncompensated water cost to the projects' users.

About a third of hydroelectric plants in California licensed by the Federal Energy Regulatory Commission (FERC) must undergo review and relicensing by 2015. Because FERC issues licenses for a period of 30-50 years, relicensing provides an opportunity to assess and change license conditions for many facilities over a relatively short period. Many of these facilities were designed, constructed, and licensed before environmental laws like CEQA and NEPA were in effect and before the California Supreme Court clarified, in National Audubon Society v. Superior Court of Alpine County (1983), the State's public trust responsibilities to protect the people's common heritage of streams, lakes, marshlands and tidelands. The result is that planning for many projects did not fully evaluate potential impacts to rivers in the timing and volume of instream flows, sediment transport, water temperature, and fish passage. Operational changes are being made during relicensing to ensure that the projects are in compliance with modern environmental laws, public trust, public policy and the public interest.

Global climate change has also prompted discussion of system reoperation. The specific effects of global climate change on water resource management in California are uncertain. Climate change could result in altered snowpack accumulation and melting, runoff patterns, water supply, sea level, floods and droughts, water demands, water temperature, plant and animal life including livestock, hydroelectric power, wild fires, recreation, water quality, soil moisture, groundwater, and ecosystems. California water managers continue to evaluate climate change and study ways of incorporating flexibility into the system to respond to climate change.

Potential Benefits of System Reoperation

Statewide benefits of system reoperation are difficult to estimate since the potential benefits are generally project-specific. The State Water Project and Central Valley Project have integrated operations since the 1970s with annual agreements that were eventually finalized in 1986 with the signing of the Coordinated Operating Agreement. This agreement has led to significant improvement in how the two projects coordinate to provide water to meet consumptive and environmental uses. The CALFED Bay-Delta Program is evaluating system reoperation, including recirculation of Delta exports, to manage salinity in the San Joaquin River. Part of this reoperation would

be to use excess capacity from the Tracy pumping plant, the Delta Mendota Canal, the SWP Banks pumping plant, or the California Aqueduct to convey water for subsequent release into the San Joaquin River to reduce salinity concentrations.

System reoperation integrates multiple resource management strategies such as surface storage, conveyance facilities, conjunctive management, water-dependent recreation and ecosystem restoration, which can:

- Reduce conflicts between competing beneficial uses and allow for improvements to the beneficial uses including environmental, recreational, water quality, and water supply objectives.
- Provide additional flexibility to respond to extreme hydrologic events like flood and drought or catastrophic events like earthquakes.

Box 19-2 Case Example of System Reoperation
El Dorado Irrigation District's Project 184

El Dorado Irrigation District's (EID's) Project 184 highlights the potential benefits, costs, and issues surrounding system reoperation as part of FERC relicensing. Project 184 is a 21 megawatt hydroelectric and water supply project located on the South Fork of the American River and its tributaries, and on Echo Creek, a tributary to the Upper Truckee River, in the counties of El Dorado, Alpine, and Amador, California.

In February 2000, EID filed an application to renew its license with FERC. The relicensing of Project 184 involved a collaborative process to provide significantly enhanced environmental protection, improving recreational opportunities and for assuring the long-term reliability and economic viability of local water supply. In April 2003, the effort produced a settlement agreement, which has been filed with FERC as recommendations for establishing conditions for the new license:

- Lake level criteria for improved recreation opportunities
- Improved aquatic habitat via new stream flow criteria in more reaches of stream
- Pulse flows in regulated reaches to mimic natural hydrologic condition peak flows
- Recreation facility improvements including a new boat ramp, campground access improvements, whitewater boating access improvements
- Fish screens at diversions from Alder and Carpenter Creeks
- Public information system of real-time lake and flow data via internet and phone
- Stream restoration in previously scoured reaches
- Sensitive species, fish and water quality monitoring
- Various environmental protection plans for operation, maintenance, and future capital projects
- Ecological resources adaptive management program

Although implementation of the new license conditions may result in a slight reduction in revenues depending on future power values, revenues from power generation can be augmented with revenues from consumptive water deliveries in order to fund project costs. EID benefits by maintaining the power generation features of the project because revenues from hydroelectric power generation offset the majority of project costs which are largely driven by the cost of water conveyance, an integral system component that would exist with or without power generation capability.

Even with the collaborative process and settlement agreement, the proposed reoperation is not entirely free of controversy. At least one interested party representing some of the recreation and business interests around Caples and Silver lakes has not signed on to the settlement agreement because of concerns about potential economic and quality of life impacts from the revised operation. Although lake level and streamflow conditions under the system reoperation would generally be enhanced for recreation interests compared to historic project operations, disagreement continues over what lake levels should be maintained during the summer and fall recreation season, if the lakes refill from year to year, and how low lake levels will be allowed to drop during dry years.

Potential Costs of System Reoperation

The potential direct costs for implementing system reoperation are project-specific and are difficult to extrapolate to a statewide estimate. Up-front costs may include performing the feasibility studies, completing California Environmental Quality Act and National Environmental Protection Act analysis, and undergoing water rights permitting to implement a proposed change in operation. These studies alone can cost millions of dollars and take several years to complete. Long-term costs may include capital costs for the construction, modification, or removal of facilities, loss of revenue from reduction in sale of hydropower or water supplies, and increased operations and maintenance costs.

Major Issues Facing System Reoperation

Reduced Hydropower Generation

System reoperation has the potential of shifting some water use from hydropower generation to other uses. Preliminary analyses by the California Energy Commission indicate that project-specific and cumulative reductions in hydropower generation associated with FERC relicensing are not significant on a systemwide basis in California. However, many facilities must still undergo relicensing and the effects of these on energy generation must be evaluated. Improved generating equipment and technology can offset some of this energy reduction. There may be a need to provide for alternative sources of energy to make up any reduction in hydropower generation. If reoperation occurs on a large scale, switching to fossil fuels to offset these reductions in hydropower generation could increase air pollution, and reliance on imported energy sources.

Gaps in Scientific Knowledge and Data

There are several significant knowledge gaps that should be addressed to improve the likelihood of successful system reoperation. There is a need for greater understanding of the relationships between flow patterns, the response of aquatic ecosystems, and how these relate to protecting public trust resources. While this area of applied environmental science is developing quickly, there is a need to improve the understanding of the effects of pulsed and ramped flows upon endangered species, other aquatic species, habitats, and river morphology. Lack of baseline data and good bio-hydrologic models for some ecological components are limiting factors. Biological opinions issued by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service have provided some guidance on specific changes in operation that would benefit specific endangered species. There is also a gap in the understanding of the specific effects associated with global climate change on local water systems. Changes in the timing and distribution of precipitation and runoff within the state can create greater uncertainty, potentially requiring changes to the management of the water system. There is a need for improved runoff prediction and other scientific information to support water management decisions.

Competing Beneficial Uses

In some cases, the analysis of reservoir reoperation can be as complex and controversial as that associated with new facility construction. Because many dams and conveyance have been operating the same way for decades, it is important to consider the interests of today's beneficiaries before introducing dramatic changes. For example, many reservoirs have existing uses including recreation, summer homes, wetland habitat and fisheries. In addition, reoperation could have unintended impacts to existing ecological processes; those impacts must be evaluated. There is concern about direct and indirect impacts on other users including downstream water rights, the environment, recreational uses, and energy production.

Conveyance Constraints

The capacity of reservoir outlets, storage, pumping, and conveyance might limit the ability to perform system reoperation through such things as water transfers, conjunctive management or revised flood operations.

Area of Origin Water Rights

Historically, area of origin water rights have not been widely exercised, but they are increasingly of interest as rural counties develop. It may be possible for these areas to develop agreements with project operators to meet some of these projected demands through reoperation of existing facilities rather than through construction of new facilities. However, new facilities may provide more flexibility to the overall management of the system. Agreements with existing facility operators to change operations would need to consider existing uses.

Integrating Water Resource Management

There are many tiers of management of developed water resources. These include facilities that are operated for local, regional, or statewide beneficial uses. Implementing system reoperation to obtain wider system benefits can require regulatory actions by several local, State, and federal agencies. For example, hydropower relicensing may include actions by

the California Department of Fish and Game, the State Water Resources Control Board, the U. S. Forest Service, U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Federal Energy Regulatory Commission. Efforts to increase coordination among both the physical operation of the facilities and the regulatory agencies can result in greater opportunities to achieve broader benefits within each watershed.

Implementation Costs

Significant up-front and on-going costs can be involved with system reoperation. Costs might include developing monitoring systems, hydrologic models, decision support systems, and collecting data to evaluate benefits and impacts of proposed changes. Other costs are associated with conducting feasibility studies, completing CEQA/NEPA analysis, and constructing new or modifying or removing existing facilities. Agencies might have difficulty raising the needed funds because of existing contracts or regulations that prohibit them from increasing water or energy rates.

Water Quality

Water quality can restrict the ability to modify existing operations for other benefits. For example, the need to maintain cold-water temperature reserves in reservoirs for downstream fisheries may prohibit reducing reservoir storage levels during the certain seasons for water supply. Reoperation using surface water to actively recharge groundwater banks may be limited by existing groundwater or recharge water quality. Water quality is often more critical for reoperation for local benefits than for regional and statewide benefits.

Recommendations to Further System Reoperation

1. The following recommendations (bulleted items) are derived from the California Energy Commission's Public Interest Energy Research Program to gain a better understanding of the effects of flow release patterns on California stream habitats and biotic communities:
   - Review the availability and quality of scientific data related to the ecological impacts associated with the operation of water management facilities.
   - Determine the adequacy of current and new sampling and analytical methods to detect and predict potential effects.
   - Develop a recommended protocol for assessing possible ecological impacts.
   - Develop and disseminate research to enhance scientific understanding and assessment of effects.
2. The State should provide financial and technical assistance for feasibility studies and evaluations that could lead to enhanced management of water resources through system reoperation. Give priority for funding and technical assistance to system reoperation projects with multiple benefits.
3. The State should continue to study the potential impacts of global climate change on water management in California and develop potential strategies to respond to these impacts.
4. Project operators should improve runoff forecasting and decision support systems for reservoir reoperation to manage water resources among competing demands.
5. The State should support research that improves our understanding of flow alteration effects on aquatic ecosystems and support development of management tools to address these effects.

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